U.S. Department of Transportation
Federal Highway Administration

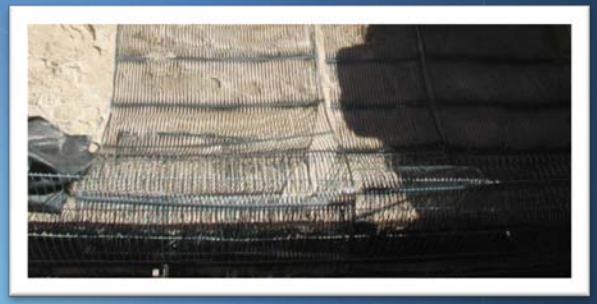
GEOSYNTHETIC REINFORCED SOIL INTEGRATED BRIDGE SYSTEM

(GRS-IBS)

Technology Overview

History

- Reinforced earth has been used for thousands of years. Ancient reinforcing materials have included:
  - Straw
  - Tree branches
  - Plant material
- Mechanically Stabilized Earth (MSE)
  - 1960s: Steel strips (Reinforced Earth®)
  - 1980s: Geosynthetic reinforcement



History *Continued*

- Geosynthetic Reinforced Soil (GRS)
  - U.S. Forest Service -- geotextiles for wrapped face walls (i.e. burrito walls) in the ‘70s
  - Colorado DOT -- frictionally connected modular blocks as the facing in the early ’80s
  - FHWA refined this method for load-bearing applications (i.e. GRS-IBS) in 1995.
    44 bridges w/a GRS abutment in the U.S.
    (27 of those GRS-IBS)
  - In 2010, GRS-IBS was selected as an EDC initiative

History *Continued*

- Manual which will be completed the end 2010
- Based on almost 40 years of research and experience.
- In the US more than 100,000 square face feet of GRS retaining wall during the last 30 years.

The Current Bridge Situation

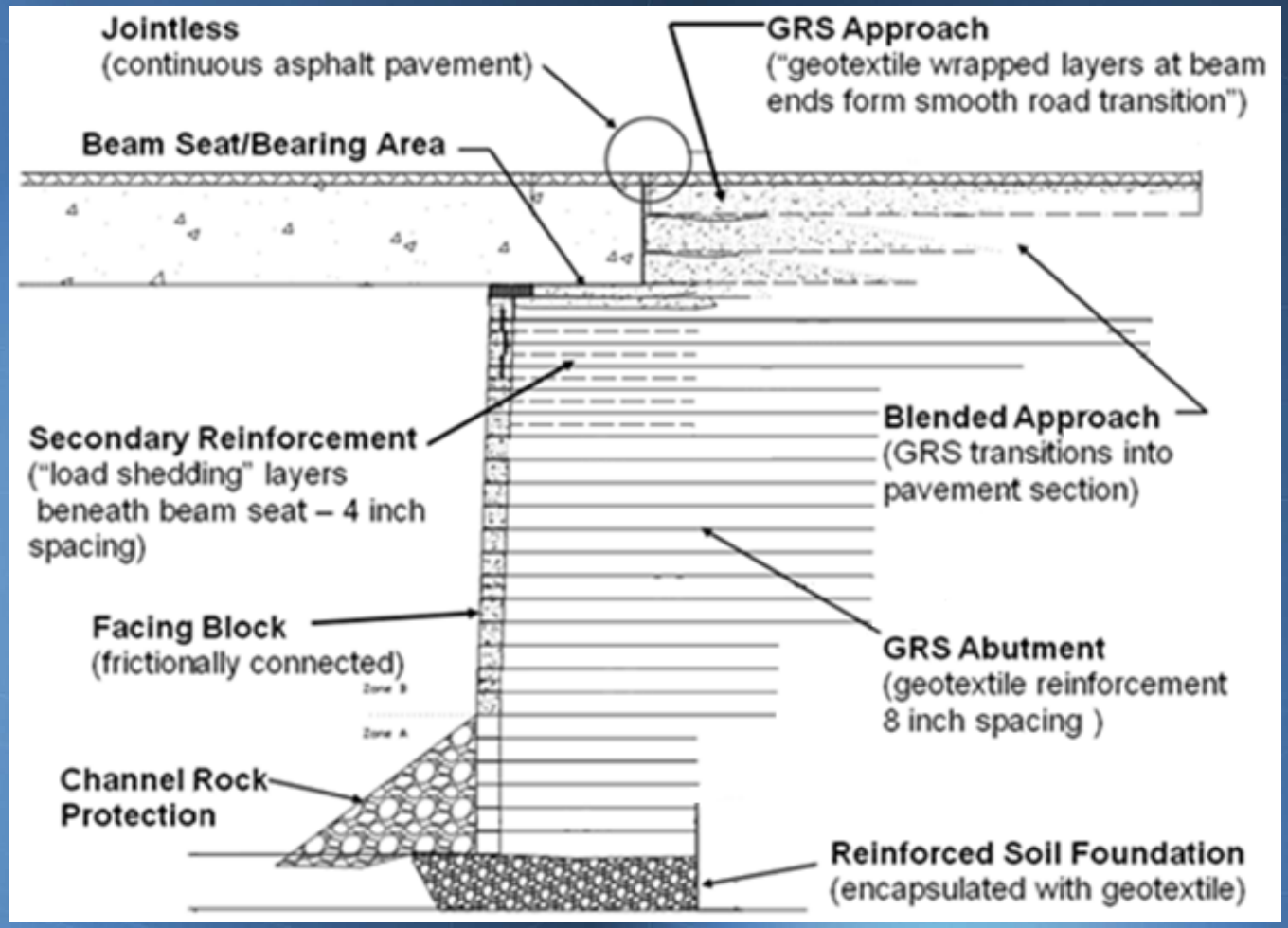
- Approximately 600,000 bridges in the U.S.
- Many have functional or structural deficiencies
- Most are small single span (typically 70’ - 90’)
- Budgets don’t meet demand – Build more bridges for your dollar

Definitions

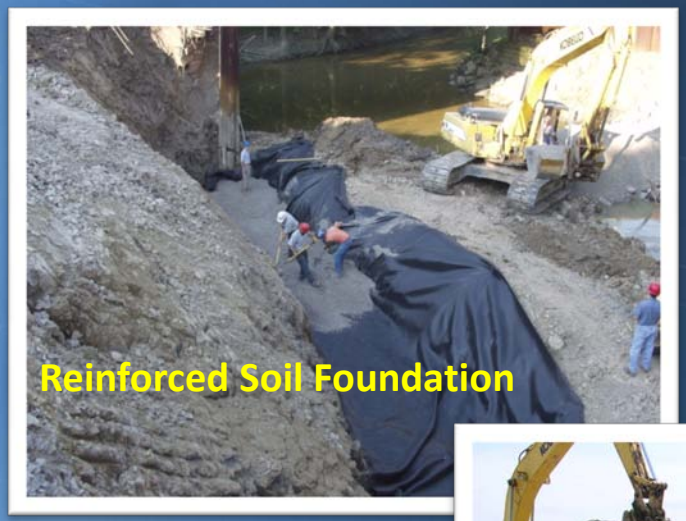
- GRS - Geosynthetic Reinforced Soil
  - An engineered fill of closely spaced (< 12”) alternating layers of compacted granular fill material and geosynthetic reinforcement
- IBS - Integrated Bridge System
  - A fast, cost-effective method of bridge support that blends the roadway into the superstructure using GRS technology

Cut-away of a GRS Mass

Cross-Section of GRS-IBS



Components of GRS-IBS



Components of GRS-IBS *Continued*

- The GRS-IBS is compatible with the use of Prefabricated Bridge Elements and Systems (PBES)

Representative Costs

	Abutment	
Built by	Height (ft)	Cost (ft^2)
County	20	$25
	14	$21
	9	$28
Contractor	16	$33

Construction	
Includes	**Does Not Include**
Reinforced Soil Foundation	Superstructure
Abutment	Paving
Integrated Approach	Earthwork
	Removal of Existing Structure
	Incidentals (e.g. Guardrail)

Site Selection

- Single span (max up to 140 ft)
- 30 ft abutment height
- Grade separation
- Low velocity stream crossings
- Steel or concrete superstructures
- New or replacement structures

Benefits: Speed of Construction

Benefits: Reduced Construction Cost

Cost Comparison: Bowman Project (Ohio)

	GRS	Conventional	Difference	% Difference
Abutment	$95,000	$105,000	$10,000	10%
Beams & Waterproofing	$171,000	$233,000	$62,000	27%
Total	$266,000	$338,000	**$72,000**	**21%**

Benefits: Reduced Construction Cost

Cost Comparison: CR12 Project (New York)

	GRS	Conventional	Difference	% Difference
Material	$160,000	$300,000	$140,000	47%
Labor	$50,000	$150,000	$100,000	67%
Equipment	$30,000	$200,000	$170,000	85%
Total	240,000	650,000	**$410,000**	**63%**

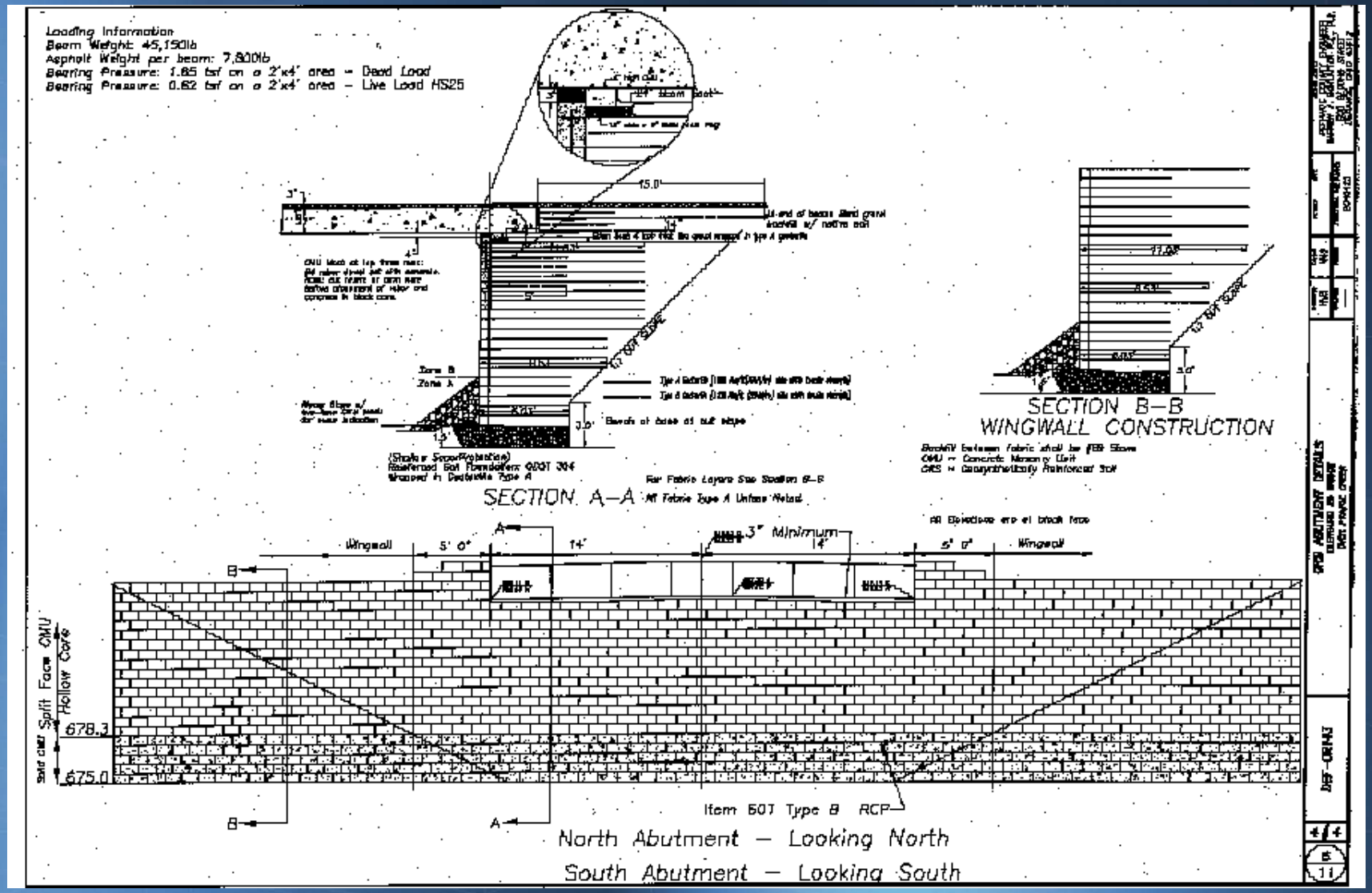

OVERSIZE LOAD

Benefits: Smooth Transition

Benefits: Non-Specialized Labor

Benefits: Simple Machinery and Tools

Benefits: Simple Plan Set



Summary of Benefits

- Reduced construction time
- Reduced construction cost (20 - 60%)
- Smooth transition
- Construction less dependent on weather conditions
- Flexible design - easily field modified for unforeseen site conditions (e.g. obstructions, utilities)
- Easier to maintain (fewer bridge parts)
- Simpler plan set

Common Materials

- Easy as 1-2-3:
  - A row of facing block
  - A layer of geosynthetic
  - Well compacted granular backfill

Recommended Materials *Continued*

Miscellaneous Materials

- Concrete block wall fill
- Rebar
- Aluminum flashing
- Foam board
- Bitumen coating

Design

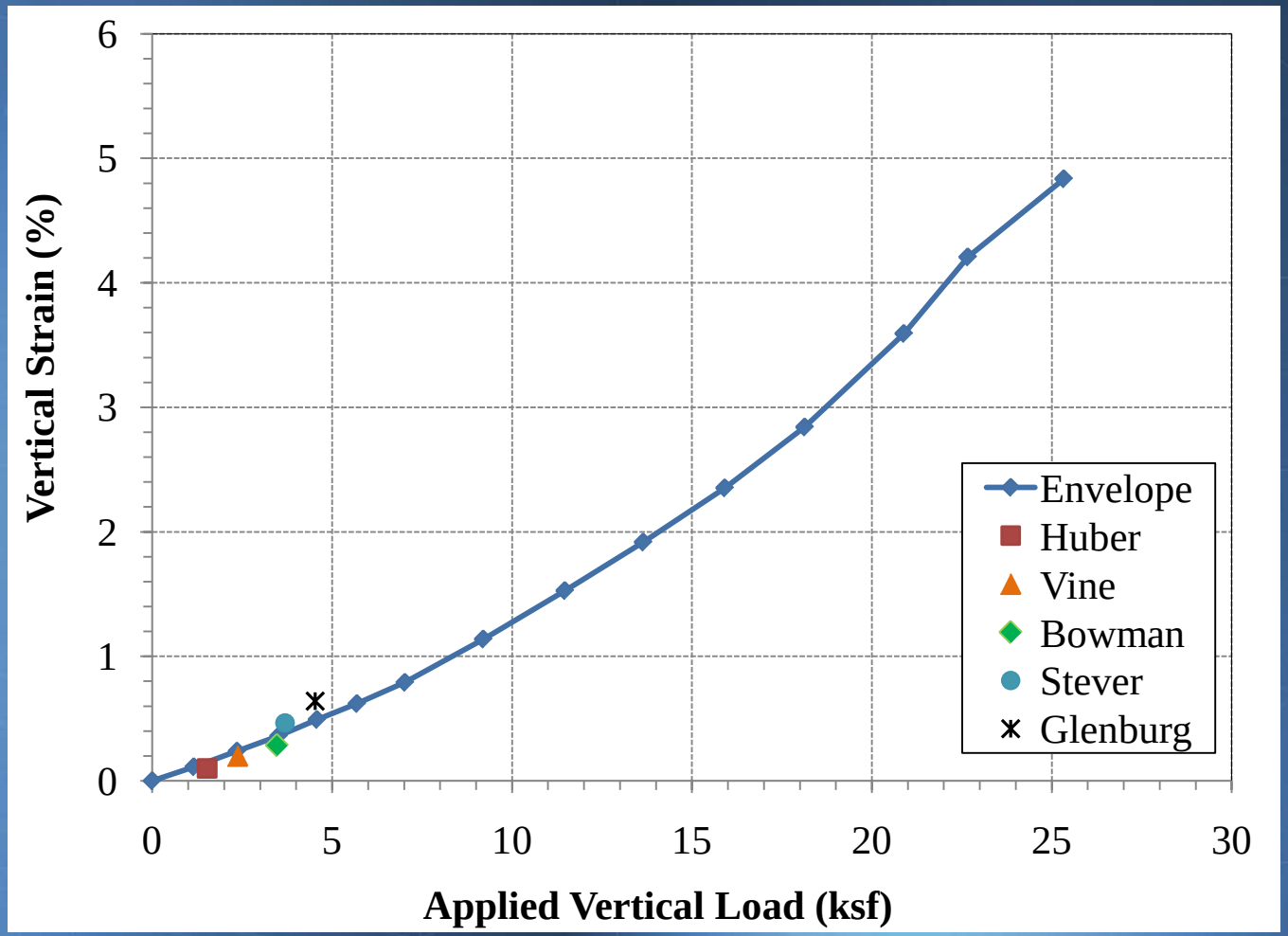
- Design and Construction Guide available by the end of 2010
  - Empirical
    - Performance Test to evaluate vertical capacity and deformations
  - Analytical
    - Equations for vertical capacity and required reinforcement strength

Performance Tests

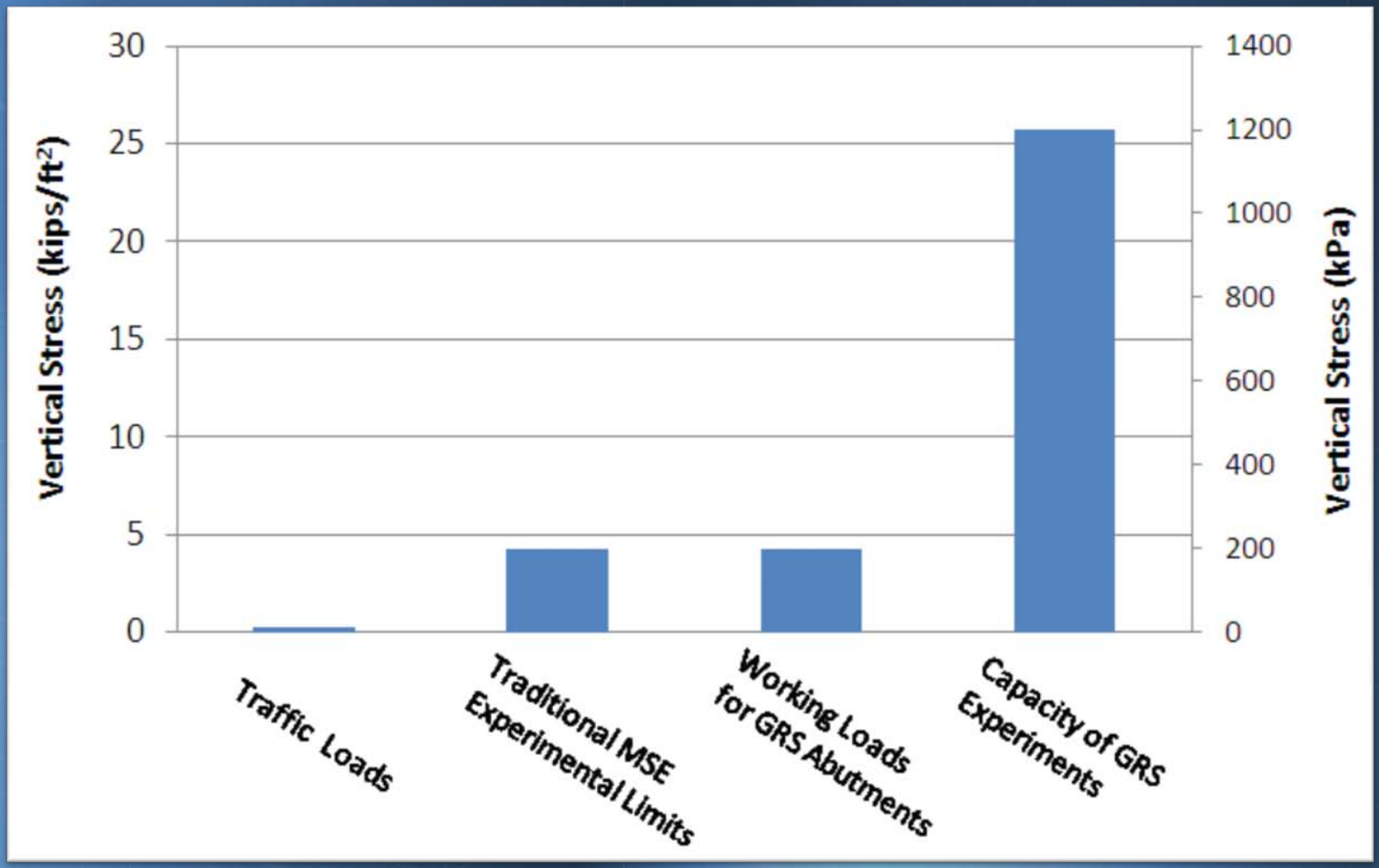
Before

After

Performance Tests *Continued*



Capacity of GRS



Some Completed Bridges


Ayersville Pleasant Bend

Behnfeldt Rd.


Casebeer Rd.


Ayersville Rd.


Huber Rd.


Beerbower Rd.


Scott Rd.

Farmer Mark Rd.


Flory Rd.

Vine St.

For More Information

- Attend Session 6: Prefabricated Bridge Elements & Geosynthetic Reinforced Soil
  - 1:00PM in Jr. Ballroom E